ARGUSV24 – Billing - Logical / Insurance - Demographic

Ⓐ   Ⓑ   Ⓒ   Ⓓ   Ⓔ

Rep Provider — 9026

repID: ID (FK)
providerID: ID (FK)

insPlan — 9008

patientID: ID (FK)
insPlanTypeID: ID
insCarrierID: ID (FK)
planName: Name
policyNumber: String
groupNumber: String

Physician - Physician Extender — 9002

repID: ID

pinNumber: <unknown>
lastName: PersonName
firstName: PersonName
middleInitial: String
credentials: Code
physicianUPIN: String
ssn: String

Demographic — 9010

patientID: ID

lastName: PersonName
firstName: PersonName
middleInitial: String
genderID: ID
dateOfBirth: Datetime
ethnicID: ID
ssn: String
countryID: ID
homePhoneNumber: PhoneNumber
homeAreaCode: AreaCode
maritalStatusID: ID
workPhoneNumber: PhoneNumber
workAreaCode: AreaCode
studentStatusID: ID

Physician Role — 9004

patientID: ID (FK)
repID: ID (FK)
repRoleID: ID

Communication — 9000

commID: ID

repID: ID (FK)
commTypeID: ID
commValue: String

patientInsurance — 9012

patientID: ID (FK)

dispositionID: ID
autoAccident: Flag
otherAccidentFlag: ID
employAccidentFlag: ID
identDesc: Description
insurerRelationID: ID
employStatusID: ID
employName: Name
placeOfServiceID: ID
authorizationNumber: String
guarantorFlag: ID

Fig. 1

1, 1 / 1, 2 – 10:20:56 AM, 9/9/99

9014

Provider Number

providerID: ID

physicianProviderNumber: String
providerTypeID: ID

9018

Insurance Carrier

insCarrierID: ID

insCarrierName: Name
addressLine1: Address
addressLine2: Address
city: Name
stateID: ID
zipCode: ZipCode
zipCodeExtension: ZipCode

9026

Guarantor

guarantorID: ID

patientID: ID (FK)
lastName: PersonName
firstName: PersonName
middleInitial: String
genderID: ID
dateOfBirth: Datetime
raceID: ID
ssn: String
countryID: ID
homePhoneNumber: PhoneNumber
homeAreaCode: Number
maritalStatusID: ID
workPhoneNumber: PhoneNumber
workAreaCode: Number
studentStatusID: ID

9024

guarantorAddress

addressID: ID (FK)
guarantorID: ID (FK)

9017

Patient Visit

visitID: ID

patientID: ID (FK)
hospDischargeFlag: Flag
icuDischargeFlag: Flag
dateEntered: Datetime
patientStatusID: ID
icuAdmitDate: Datetime
hospAdmitDate: Datetime
medicalRecordNUmber: String
sourceID: ID
hospDischargeDate: Datetime
hospDischargeID: ID
icuDischargeDate: Datetime
icuDischargeID: ID
readmitFlag: ID

9022

Address

addressID: ID

addressTypeID: ID
addressLine1: Address
addressLine2: Address
city: Name
stateID: ID
zipCode: ZipCode
zipCodeExtension: ZipCode

9020

patientAddress

patientID: ID (FK)
addressID: ID (FK)

Fig 1A

1, 2 / 1, 2 -- 10:20:56 AM , 9/9/99

Fig. 2

Patient Visit — 9017

visitID: ID

patientID: ID (FK)
hospDischargeFlag: Flag
icuDischargeFlag: Flag
dateEntered: Datetime
patientStatusID: ID
icuAdmitDate: Datetime
hospAdmitDate: Datetime
medicalRecordNUmber: String
sourceID: ID
hospDischargeDate: Datetime
hospDischargeID: ID
icuDischargeDate: Datetime
icuDischargeID: ID
readmitFlag: ID

Patient Location — 9030

locID: ID (FK)

patientID: ID (FK)
visitID: ID (FK)

Physician Role — 9004

patientID: ID (FK)
repID: ID (FK)

repRoleID: ID

Demographic — 9010

patientID: ID

lastName: PersonName
firstName: PersonName
middleInitial: String
genderID: ID
dateOfBirth: Datetime
ethnicID: ID
ssn: String
countryID: ID
homePhoneNumber: PhoneNumber
homeAreaCode: AreaCode
maritalStatusID: ID
workPhoneNumber: PhoneNumber
workAreaCode: AreaCode
studentStatusID: ID

Physician - Physician Extender — 9002

repID: ID

pinNumber: <unknown>
lastName: PersonName
firstName: PersonName
middleInitial: String
credentials: Code
physicianUPIN: String
ssn: String

Communication — 9000

commID: ID

repID: ID (FK)
commTypeID: ID
commValue: String

FIG. 2A

ICU — 9032

hospitalIcuID: ID
___
hospitalID: ID (FK)
phoneNumber: PhoneNumber
faxNumber: PhoneNumber
icuWardID: ID
areaCode: AreaCode
wrskIpAddress: String
vsListener: String
icuPrinterName: Name

Hospital — 9034

hospitalID: ID
___
commandCenterID: ID (FK)
hospitalNumber: Number
hospitalName: Name
addressLine2: Address
addressLine1: Address
city: Name
stateID: ID
zipCodeExtension: ZipCode
zipCode: ZipCode

Command Center — 9036

commandCenterID: ID
___
commandCenterName: Name
addressLine1: Address
addressLine2: Address
city: Name
stateID: ID
zipCode: ZipCode
zipCodeExtension: ZipCode

ICU Bed — 9038

locID: ID
___
hospitalIcuID: ID (FK)
roomNumber: String
bedNumber: String

Camera Setting — 9040

locID: ID (FK)
___
cameraValueName: Name
cameraValue: String

Fig. 3

medicalHistoryItem 9044

medicalID: ID

noteID: ID (FK)
medicalValueID: ID
medicalText: Description
medicalTypeID: ID
medicalCategoryID: ID
medicalDate: Datetime

Note 9042

noteID: ID

visitID: ID (FK)
repID: ID (FK)
dateEntered: Datetime
noteTypeID: ID

Patient Visit 901.7

visitID: ID

patientID: ID (FK)
hospDischargeFlag: Flag
icuDischargeFlag: Flag
dateEntered: Datetime
patientStatusID: ID
icuAdmitDate: Datetime
hospAdmitDate: Datetime
medicalRecordNUmber: String
sourceID: ID
hospDischargeDate: Datetime
hospDischargeID: ID
icuDischargeDate: Datetime
icuDischargeID: ID
readmitFlag: ID

Physician - Physician Extender 9002

repID: ID

pinNumber: <unknown>
lastName: PersonName
firstName: PersonName
middleInitial: String
credentials: Code
physicianUPIN: String
ssn: String

FIG. 4

Review of System 9050
noteID: ID (FK)
reviewOfSystem: FreeText

Patient Illness 9048
noteID: ID (FK)
illness: FreeText

procLine 9046
lineID: ID
visitID: ID (FK)
locationID: ID
catheterID: ID
comments: Description
insertDate: Datetime
changeDate: Datetime
removeDate: Datetime

Patient Visit 9017
visitID: ID
patientID: ID (FK)
hospDischargeFlag: Flag
icuDischargeFlag: Flag
dateEntered: Datetime
patientStatusID: ID
icuAdmitDate: Datetime
hospAdmitDate: Datetime
medicalRecordNUmber: String
sourceID: ID
hospDischargeDate: Datetime
hospDischargeID: ID
icuDischargeDate: Datetime
icuDischargeID: ID
readmitFlag: ID

Surgery 9054
noteID: ID (FK)
estBloodLoss: Number
anethesialD: ID
surgeryDiagnosisID: ID
electiveFlag: ID

surgeryComplication 9056
complicationID: ID
noteID: ID (FK)

urgical Fluids 9052
fluidTypeID: ID
noteID: ID (FK)
fluidAmount: Number

G H I J

ARGUSV24 -- Logical Model / Notes

FIG. 4A

Daily Treatment 9062
treatmentID: ID
noteID: ID (FK)

Daily Diagnosis 9068
diagnosisID: ID
noteID: ID (FK)

Physical Exam 9074
noteID: ID (FK)
physical: FreeText

allergy 9076
allergyID: ID
noteID: ID (FK)
allergyTypeID: ID
allergyNameCode: String

dailyMentalState 9060
mentalStateID: ID
noteID: ID (FK)

Note 9042
noteID: ID
visitID: ID (FK)
repID: ID (FK)
dateEntered: Datetime
noteTypeID: ID

Physician - Physician Extender 9002
repID: ID
pinNumber: <unknown>
lastName: PersonName
firstName: PersonName
middleInitial: String
credentials: Code
physicianUPIN: String
ssn: String

Assessment Plan 9058
noteID: ID (FK)
planText: FreeText

Unstable Condition 9070
noteID: ID (FK)
unstableID: ID

MPM Information 9072
noteID: ID (FK)
mpmID: Flag

1, 2 / 1, 3 -- 10:30:28 AM, 9/9/99

FIG. 4B

logItem — 9080

noteID: ID (FK)

eventLogItem: Number
patientProfileItem: Number
neuroItem: Number
cardioItem: Number
pulmonaryItem: <unknown>
renalItem: Number
hemeItem: Number

noteItem — 9078

noteID: ID (FK)

principalDiagnosisID: ID
timeForCareID: ID
chiefComplaint: Description
sourceOfInfoID: ID
compDecisionID: ID
rosObtainID: ID
pastHistoryObtainID: ID
dischargeID: ID
peObtainID: ID
reasonForNoteID: ID
gcsID: ID
allergyFlag: Flag
surgeryFlag: Flag
complicationFlag: Flag
drugFlag: Flag
unstableFlag: Flag

procEvaluation — 9084

noteID: ID (FK)
procEvaluationID: ID

procEvaluationItemID: ID
procEvaluationText: Description

procedureNoteItem — 9082

noteID: ID (FK)

procTypeID: ID
prinicipalDiagnosisID: ID
procLocationID: ID
procIndicationID: ID
catheterTypeID: ID

procedureDesc — 9088

noteID: ID (FK)
procDescID: ID

procDescItemID: ID
procDescValue: Number

admitDrug — 9086

admitDrugID: ID
noteID: ID (FK)

nddfDrugCode: String
drugDosage: Number
dosageUnitID: ID
admitFrequencyID: ID

FIG. 5

nonDrugOrder — 9090

nonDrugID: ID

orderID: ID (FK)
orderClassID: ID
orderText: FreeText

drugOrder — 9094

drugOrderID: ID

orderID: ID (FK)
nddfDrugCode: String
orderActionID: ID
drugDosage: Number
dosageUnitID: ID
loadDosage: Number
loadDosageUnitID: ID
startDate: Datetime
routeAdminID: ID
frequencyID: ID
frequencyValue: Number
frequencyUnitID: ID
stopDate: Datetime
stopDosage: Number
slideScaleFlag: ID
needID: ID
orderClassID: ID
specialInstruction: FreeText
infusionDuration: Number
infusionTimeUnitID: ID
arrRiskID: ID
stopTimeID: ID

Medical Orders — 9092

orderID: ID

visitID: ID (FK)
repID: ID (FK)
orderSetTypeID: ID
dateOrdered: Datetime
orderNumberSet: Number
printerCounter: Number

Physician - Physician Extender — 9002

repID: ID

pinNumber: <unknown>
lastName: PersonName
firstName: PersonName
middleInitial: String
credentials: Code
physicianUPIN: String
ssn: String

Patient Visit — 9017

visitID: ID

●●tID: ID (FK)
h●●DischargeFlag: Flag
icuDischargeFlag: Flag
dateEntered: Datetime
patientStatusID: ID
icuAdmitDate: Datetime
hospAdmitDate: Datetime
medicalRecordNUmber: String
sourceID: ID
hospDischargeDate: Datetime
hospDischargeID: ID
icuDischargeDate: Datetime
icuDischargeID: ID
readmitFlag: ID

patientCodeStatus — 9096
- taskID: ID (FK)
- codeStatusID: ID

Physician - Patient Task — 9098
- taskID: ID
- visitID: ID (FK)
- taskStatusID: ID
- acuityID: ID
- dateEntered: Datetime
- dateCompleted: Datetime
- taskDesc: Description

Laboratory — 9100
- visitID: ID (FK)
- labID: ID
- specimenID: ID
- dateLabTaken: Datetime
- labCode: ID
- labType: Number

otherLab — 9102
- labID: ID
- otherID: ID
- otherName: Description

Patient Visit — 9017
- visitID: ID
- patientID: ID (FK)
- hospDischargeFlag: Flag
- icuDischargeFlag: Flag
- dateEntered: Datetime
- patientStatusID: ID
- icuAdmitDate: Datetime
- hospAdmitDate: Datetime
- medicalRecordNUmber: String
- sourceID: ID
- hospDischargeDate: Datetime
- hospDischargeID: ID
- icuDischargeDate: Datetime
- icuDischargeID: ID
- readmitFlag: ID

microSensitivity — 9108
- microOrganismID: ID (FK)
- sensitivityLevelID: ID
- antibioticID: ID

microOrganism — 9106
- microID: ID (FK)
- microOrganismID: ID
- organismID: ID

microbiology — 9104
- microID: ID
- visitID: ID (FK)
- siteID: ID
- dateTaken: Datetime
- identifyData: Description

respiratory — 9101
- visitID: ID (FK)
- respItemID: ID
- dateTaken: Datetime
- respItemResult: Number
- relatedInfo: Description

FIG. 6

9112

intakeOutputTotal

inOutID: ID (FK)
inOutTotalID: ID

weight: Number
totalIn: Number
totalOut: Number
netIn: Number
fiveDayCumlative: Number

9116

imageResult

imageID: ID (FK)
imageResultID: ID

imageLocationID: ID
resultText: Description

9110

intakeOutput

inOutID: ID

visitID: ID (FK)
inOutValue: Number
inOutValueID: ID
dateTaken: Datetime

9114

image

imageID: ID

visitID: ID (FK)
imageTypeID: ID
otherImageName: Name
datePerformed: Datetime

9118

otherOrganism

otherID: ID

microOrganismID: ID (FK)
otherName: Description

FIG. 6A

(N)

(0)

(P)

FIG. 7

Value & Combo — 9124

Value & Combo
valueComboID: ID
valueID: ID (FK)
combID: ID (FK)

Value — 9128

Value
valueID: ID
valueName: Description
seqno: Number

Category & Type — 9122

Category & Type
combID: ID
catID: ID (FK)
typeID: ID (FK)

Insurance Carrier — 9018

Insurance Carrier
insCarrierID: ID
insCarrierName: Name
addressLine1: Address
addressLine2: Address
city: Name
stateID: ID
zipCode: ZipCode
zipCodeExtension: ZipCode

Category — 9120

Category
catID: ID
catName: Name

Type — 9126

Type
typeID: ID
typeName: Name

nextKey — 9027

nextKey
nextValue: ID
tableName: Name

FIG. 8

Vital Sign Detail — 9122

visitID: ID (FK)
stampDtm: Datetime

hospitalID: ID (FK)
patientID: ID
medicalRecNumber: String
obsDtm: Datetime
sendingApp: String
msgCtlId: String
heartRate: Number
systemicSystolic: Number
systemicDiastolic: Number
systemicMean: Number
temperature: Number
saO2: Number
respiration: Number
PASystolic: Number
PADiastolic: Number
PAMean: Number
PAOP: Number
CVP: Number
etCO2: Number
CO: Number
ST1: Number
ST2: Number
ST3: Number

Vital Sign Header — 9120

visitID: ID (FK)

stampDtm: Datetime
hospitalID: ID (FK)
patientID: ID
medicalRecNumber: String
patientName: PersonName
patientLastName: PersonName
patientFirstName: PersonName
patientClass: Code
carenetNum: String
carenetBedNum: String

Hospital — 9034

hospitalID: ID

commandCenterID: ID (FK)
hospitalNumber: Number
hospitalName: Name
addressLine2: Address
addressLine1: Address
city: Name
stateID: ID
zipCodeExtension: ZipCode
zipCode: ZipCode

Patient Visit — 9017

visitID: ID

patientID: ID (FK)
hospDischargeFlag: Flag
icuDischargeFlag: Flag
dateEntered: Datetime
patientStatusID: ID
icuAdmitDate: Datetime
hospAdmitDate: Datetime
medicalRecordNUmber: String
sourceID: ID
hospDischargeDate: Datetime
hospDischargeID: ID
icuDischargeDate: Datetime
icuDischargeID: ID
readmitFlag: ID

Demographic — 9016

patientID: ID

lastName: PersonName
firstName: PersonName
middleInital: String
genderID: ID
dateOfBirth: Datetime
ethnicID: ID
ssn: String
countryID: ID
homePhoneNumber: PhoneNumber
homeAreaCode: AreaCode
maritalStatusID: ID
workPhoneNumber: PhoneNumber
workAreaCode: AreaCode
studentStatusID: ID

ARGUSV24 -- Vital Sign - Logical / Vital Signs

FIG. 8A

9120

Vital Sign Log Header

hospitalID: ID
medicalRecNumber: String

stampDtm: Datetime
patientName: PersonName
patientLastName: PersonName
patientFirstName: PersonName
patientClass: Code
carenetNum: String
carenetBedNum: String

9130

Vital Sign Error Header

hospitalID: ID
medicalRecNumber: String

stampDtm: Datetime
patientName: PersonName
patientLastName: String
patientFirstName: String
patientClass: Code
carenetNum: String
carenetBedNum: String

9124

Vital Sign Log Detail

hospitalID: ID (FK)
medicalRecNumber: String (FK)
stampDtm: Datetime

obsDtm: Datetime
sendingApp: String
msgCtlId: String
heartRate: Number
systemicSystolic: Number
systemicDiastolic: Number
systemicMean: Number
temperature: Number
saO2: Number
respiration: Number
PASystolic: Number
PADiastolic: Number
PAMean: Number
PAOP: Number
CVP: Number
etCO2: Number
CO: Number
ST1: Number
ST2: Number
ST3: Number

9126

Vital Sign Error Detail

hospitalID: ID (FK)
medicalRecNumber: String (FK)
stampDtm: Datetime

code: String (FK)
obsDtm: Datetime
sendingApp: String
msgCtlId: String
heartRate: Number
systemicSystolic: Number
systemicDiastolic: Number
systemicMean: Number
temperature: Number
saO2: Number
respiration: Number
PASystolic: Number
PADiastolic: Number
PAMean: Number
PAOP: Number
CVP: Number
etCO2: Number
CO: Number
ST1: Number
ST2: Number
ST3: Number

9128

Vital Sign ErrorCode

code: String

description: String

9132

CarenetPatientLocation

hospitalID: ID
carenetNum: String
carenetBedNum: String

locID: ID (FK)

9038

ICU Bed

locID: ID

hospitalIcuID: ID (FK)
roomNumber: String
bedNumber: String

Distributed Architecture

Hospital

Patient Rooms

Bedside Monitors / Video — 234

Bedside Monitors / Video — 232

Monitor Server — 222

Nursing Station — 204

Video / Monitor — 230

Patient Info Front End — 228

Command Center — 202

HL7 Interface

HL7 Gateway — 214

Monitor Front End — 218

Monitor Front End — 216

Legacy Front End — 220

Database Server — 222

Video / Monitor — 212

NT/IIS/App Server — 224

Patient Info Front End — 226

Legacy Databases — 210

HQ — 200

Database Server / Warehouse — 208

Patient Info Front End — 206

Replication

Fig. 9

Fig 10

IC-USA
System
Architecture

Command Center 202

Frame Relay 256k

Headquarters 200

Intensive Care Unit 204

point-to-point T1

Video Conferencing/Surveillance/Imaging Components

Hospital

Multiport Serial Controller — 286

Scanner — 282

278

280

Video Codec — 304

Audio Line Out

Audio Amplifier — 302

Audio Line In

RS-232 Port
RS-232 Port

RS-422 Serial Port

RS-422 to RS-232 Converter — 288

RS-232 Control

Audio/Video Switcher — 292

Reverse Audio Switcher — 298

Audio Feed

Audio Line Amplifier — 294

Video Feed

Mic Feed

Audio Feed

Video Camera — 290

296

300

204

Command Center

252

- ➤ Hot Phone Access
- ➤ Scanner Control
- ➤ Audio/Video Switcher and Camera Control
- ➤ Remote Surveillance Display

202

Fig 11

Vital Signs Data Flow

Manufacturer Vital Sign Monitoring System — 450

Capture Vital Sign Data — 452

Transmit Vital Sign Data — 454

Display Real Time Vital Data — 472

Process Vital Sign (HL7) Data for Storage purposes — 456

Load Data Into Database — 458

Process Rules for Vital Sign Threshold & Temporal Data — 460

Display Vital Sign Alarming — 462

Vital Sign Data — 464

Transmit Vital Sign Data — 466

Load Data Into Database Warehouse — 468

Vital Sign Data — 470

Fig. 13

Patient Interaction Data Flow

472 — Transmit X-Ray Image to Command Center

474 — Capture X-Ray Image

476 — Display the Image on Monitor

Fig 13A

478 — Establish Video Conferencing Session

480 — View Patient or Nurse

482 — Communicate with Physician

Fig 13B

PHYSICIAN RESOURCES AND
ORDER WRITING DATA INTERFACE

Fig14

484

```
            USER
          INTERFACE
```

478
```
          Resident
          Database
```

486
```
         Physician
         Resources
```

488
```
      Enter Antiobiotic
        Associated
          Colitis
```

500
```
    Generate Order
    to Micro-Biology
```

502
```
      Order Writing
```

496
```
         Order
        Writing
       Assignment
        Manager
```

490
```
       Request for
      Fecal Leukocyte
       Test and
          EXIT
```

504
```
       Task List
```

492
```
       RE-ENTER
       Physician
      Resources at
      Location with
        Results
```

506
```
      Order Resulted
```

494
```
      Continue with
       Diagnostic
        Algorithm
```

fig 15

PHYSICIAN RESOURCES
DATABASE DATA INTERFACE

508

USER INTERFACE

524 — Resident Database

510 Physician Resources

522

526 — Admission Diagnosis Pancreatitis

Diagnosis Pancreatitis Alerts MD to Physician Resources

512 Enter Topic Pancreatitis

528 — Operative Data

514 Enter Diagnostic Algorithm

530 — Vital Signs

538 Apache* II Assignment Manager

516 Request for Apache II Score

532 — Laboratories

534 — Past Medical History

Score ≥ 8

Score < 8

520 Continue with Diagnostic Algorithm

518 Patient triaged to Non-ICU bed

536 — Demographics

*Assigns Apache II Score based upon weighted composite of 25 variables

AUTOMATED CODING/BILLING WORKFLOW/DATA FLOW

Fig 14

3/30/99

Visit — 540

514 — Resident Argus Data

ARGUS INTERFACE

User Input GUI — 542

ICD9 Diagnosis Code ✓
MDM Complexity ✓
Stable/Unstable ✓
Consulting / Attending ✓
New / Established PT ✓
Progress note ✓

Data Manager — 546
User definable data mapping GUI

Assembles required data elements for processing

Patient Demographics
Insurance
Physician
Guarantor
Dates of service

Demographic
Physician
Encounter
Guarantor
Insurance

Management Reports — 556

Clinical — 558

CPT Code Assignment Manager
Assigns CPT code based on scores and user input
Will have user definable rules tables

Bill Generator — 548
Assembles data elements needed to generate a HCFA 1500

User Verification CCI Edits — 550
MD Verifies selected code
CCI Edit messages displayed for MD
MD can disagree with code assignment and return to progress notes
MD can override?

Pass or Override

Fail

HCFA 1500 Claim Form — 554
Produce HCFA 1500 on paper and print image

Billing Data File NSF — 552
NSF file for import to Patient Accounting System

HPI Score — 560
ROS Score — 562
PFSH Score — 564
PE Score — 566
MDM Score — 568

Scores use return a score of the exams performed in each section of HCFA guidelines
Will have user definable rules tables

ICUSA

06/11/99 FRI 16:20 FAX 410 27 870

@007

Order Writing Flow Sheet

Order entry user interface — *600*

604 ECG ordered | Medication ordered — *602*

612 db

614 allergies

608 Order checking system

checks for allergies

checks for drug interactions

medication list

checks renal function to insure correct dose

lab data

order ok'd

606 order review & signature module

orders

607 order approved

task list

610 data output system

adds "check ECG" to task list

records order in EMR

updates medication list

prints orders

exports info in HL7

Printer in (ICU — *616*

Hospital data systems — *618*

Fig 17

Event Log

The event log presents in a single location key clinical information from throughout a patient's stay in the ICU. The event log provides care givers with a snapshot view of all salient events since admission. All relevant data are presented chronologically.

SMART ALARMS

636

monitor

HL7
output

→

interface 638

VS data formatted for storage

db 640

Vital Signs

other patient data

Fig 19

644

alert screen

rule parameter met
status (condition/severity) sent to alert screen

642
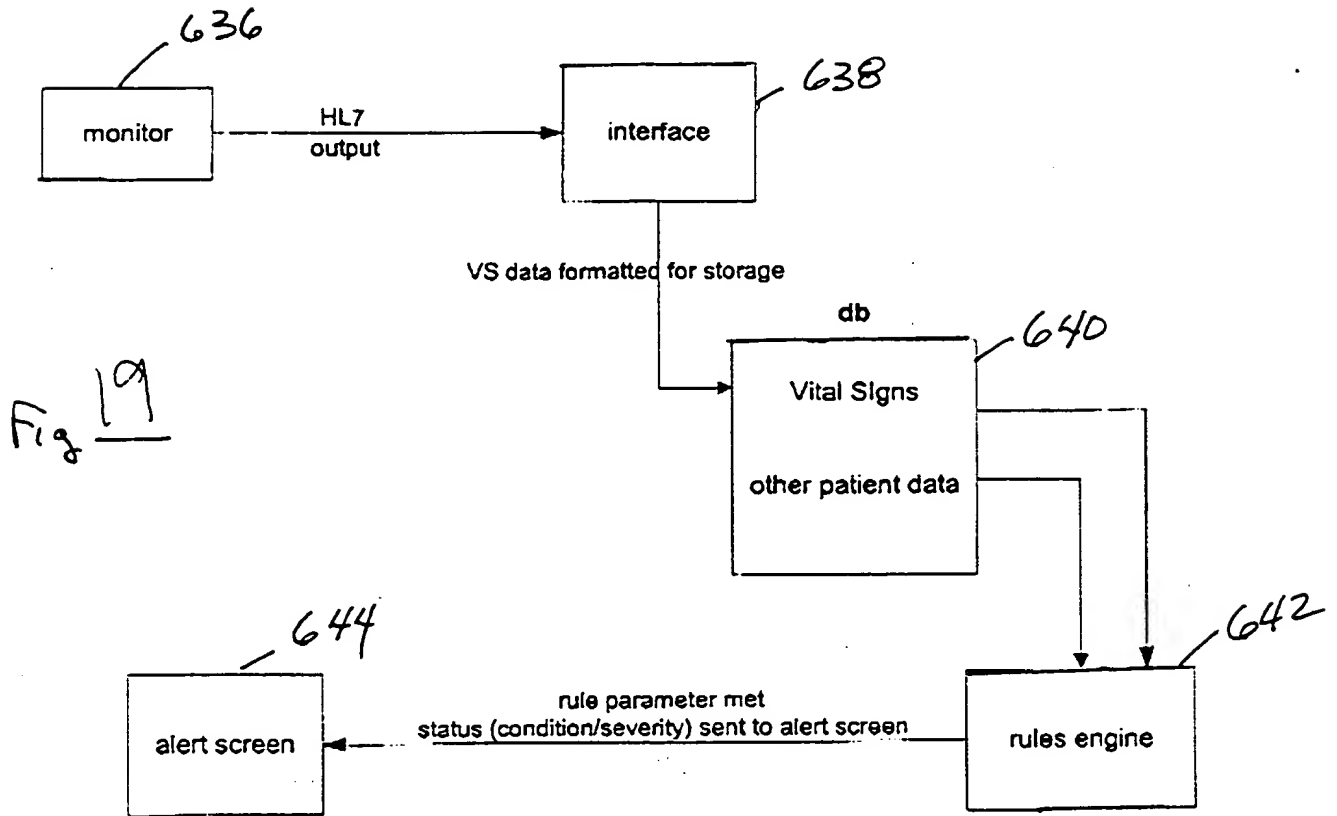
rules engine

The smart alarm system constantly monitors physiologic data (collected once a minute from the bedside monitors) and other clinical information. The rules engine searches for patterns of data indicative of clinical deterioration. Examples include changes in vital signs over time (e.g. a 25% increase in the HR and a 20% decrease in BP), parallel reductions in urine output and central venous pressure that suggest developing hypovolemia, and progressive reductions in hemoglobin concentration over time that indicate a need to exclude active bleeding (and a possible need to administer blood). When rule conditions are met, relevant informaton is displayed on the system "alert screen".

The rationale underlying smart alarms is to facilitate detection of impending problems and to automate problem detection.
The system balances alarm sensitivity and specificity in order to maximize the benefit of the alarms to the intensivist.

Procedure Note Creation User Interface

646

New catheter inserted — 648

Existing catheter changed over a wire — 650

db

fig 20

note created

652

Line ID module

664

Existing catheter identified from line log

line log

notes

note created

Note review and signature module — 654

note approved

656

data output system

note stored in EMR

line log updated

Print Note

Export info in HL7

658 — Printer (in ICU)

Hospital data systems — 660

662

billing module

Bill generated/submitted

The line log contains, for each patient, relevent information about all indwelling catheters, including type and location of catheter, insertion date, the most recent date that the catheter was changed over a wire, and the date the catheter was removed. This information helps clinicians evaluate the likelihood that a given catheter is infected and guides management.

Acalculous Cholecystitis

Figure 21

Is the patient clinically infected? (febrile, leukocytosis). —No→ Unlikely patient has acalculous cholecystitis. *802*

Yes ↓

806 Acalculous cholecystitis very unlikely. ←Yes— Has the patient had a previous cholesystectomy? *804*

No ↓

Does the patient have any of the following risk factors? *808*
1) Prolonged ICU stay (> 6 days)
2) Recent Surgery (particularly aortic cross clamp procedures
3) Hypotension
4) PEEP > 10 cm
5) Transfusion (> 6 units)
6) Inability to use GI tract for nutrition.
7) Immunosupression (AIDS, transplantation, leukemia).
—No→ Probably not acalculous cholecystitis. *810*

Yes ↓

Does the patient have:
RUQ Tenderness?
Elevated alkalinephosphatase?
Elevated bilirubin?
Elevated livert transaminases? *812*
—No→ Consider other more likely sources of infection (see FUO). If infection remains undiagnosed following alternative work-up, re-enter algorithm. *814*

Yes ↓

Is the patient stable enough to go for a test? *818* ←Yes— Are alternative intra-abdominal infectious sources more likely? *816* —No→ Is the patient stable enough to go for a test? *826*

Yes ↓ (818)   No ↓ (816)   No (826)

Do abdominal CT scan. *820*   Do bedside ultrasound. *828*

No other infectious etiologies identified and abnormalities of the gall-bladder noted, but: *830*
a) patient remains ill
b) patient improving.
→ Consider empiric Cholecystostomy. *832*
→ Continue to observe. *834*

No other infectious etiologies apparent and test *822*
a) demonstrates abnormalities of the gall blader but not diagnostic
or
b) no gall-bladder abnormalities noted.
—No→ Do mso4 Cholescintigraphy. *836*

Yes ↓

Continued observation. *824*

Yes ↓ (836)

Normal AC Excluded. *838*

Abnormal test- Consider Cholecystectomy or precutaneous drainage. *840* ←

Figure 22

900

Adrenal insufficiency

902

Is the patient hypotensive (systolic <90 mmhg) and/or been on pressors for ≥ 48 hours? —no→ Adrenal insufficiency unlikely

yes

904

Is there an obvious cause for the hypotension and/or pressor need?
- Hypovolemia
- Myocardial Dysfunction
- Spinal injury

906

yes   no

Treat underlying cause first; If cause reversed and hypotension / pressor need persists

908

1.
Has patient been treated with steroids within the last 6 months for ≥ 2 weeks?

910

2.
Does the patient have
1)Hyponatremia (Na < 130 mmol/L) and
2)Hyperkalemia (>5 mmol/L)

916

Results of Cosyntropin Stim test
1) What was the baseline cortisol level?(prior to cosyntropin) ____mcg/dl?
2) What was the cortisol level 30 minutes following cosyntropin stimulation? ____mcg/dl?

914

Administer cosyntropin 250 mcg IV

912

3.
Was the patient anticoagulated or coagulopathic prior to developing hypotension / pressor needs?

918

Treatment Action

Blunt Cardiac Injury

Figure 23

1000 Are any risk factors present?

No → *1002* No further evaluation necessary

Yes → *1004* Obtain an ECG and CXR

1006 Are either the ECG or CXR abnormal?

Yes

No → *1008* Monitored Bed Unnecessary

1010 Is there any hemodynamic instability that cannot be explained by hypovolemia, spinal cord inury or sepsis?

Yes → *1020* Do stat echo
If blunt thoracic aortic injury also suspected, TEE favored over TTE

No → *1012* Monitored bed
Repeat ECG at 24 hrs.
At any time if unexplained hemodynamic instability, do stat echo.
If blunt thoracic aortic injury also suspected, TEE favored over TTE.

1022 Is echo abnormal?
- Pericardial effusion (tamponade)
- Hypokinesis or akinesis (wall motion)
- Dilatation or reduced systolic function
- Acute valvular dysfunction
- Chamber rupture

Yes → *1026* Treat as indicated

No → *1024* Continue to monitor and repeat ECG at 24 hours

1014 Is ectopy, arrhythmia, or abnormality present on the ECG?

Yes → *1018* Consider monitoring for additional 24 hours

No → *1016* Cardiac injury excluded

CANDIDURIA

Does the patient have:
1. Diabetes?
2. GU anatomic abnormality?
3. Renal transplant?
4. Pyuria?

— 1100

No → Is there evidence of dissemination? — 1102

No →
1. Change catheter
2. Reculture in 24 hrs
3. Check for pyuria

— 1104

Yes → Can the patient take P.O.? — 1106

No → Systemic Ampho — 1114

Yes → Has the patient been on azoles within 3 days? — 1108

Yes → Systemic Ampho — 1110

No →
1. Fluconazole 400 mg P.O, then 200 mg q24
2. Check fungal speciation.
   a. If C. Krusei: change to Systemic Ampho
   b. If C. Glabrata: change fluconazole 1600 mg load, then 800 mg q 24

— 1112

Yes → Is there evidence of dissemination? — 1116

Yes → Can the patient take P.O.? — 1118

No → Systemic Ampho — 1120

Yes → Has the patient been on azoles within 3 days? — 1122

Yes → Systemic Ampho — 1124

No →
1. Fluconazole 400 mg P.O, then 200 mg q24
2. Check fungal speciation.
   a. If krusei: change to Systemic Ampho
   b. If glabrata: change fluconazole 1600 mg load, then 800 q 24

— 1126

No → Can the patient take P.O.? — 1128

No → Ampho Bladder Washing — 1130

Yes → Has the patient been on azoles within 3 days? — 1132

Yes → Systemic Ampho — 1134

No →
1. Fluconazole 400 mg P.O, then 200 mg q24
2. Check fungal speciation.
   a. If krusei: change to Systemic Ampho
   b. If glabrata: change fluconazole 1600 mg load, then 800 q 24

— 1136

Figure 24

Cervical Spine Injury   **Figure 25**

1200

Is the patient awake, alert, not intoxicated and have no mental status changes?

——Yes——

No

1232

Does the patient have severe head trauma?

——Yes——

1236

No

Order CT of neck with head CT

1202

Does the patient have any neck pain?

——yes——

1210

Order 3 x-rays*

No

1204

Does the patient have any other pain which would distract from their neck pain?

1212

——Normal——

Consider extension, then flexion lateral x-rays. If normal can remove coller. If abnormal obtain surgical consult.

Abnormal——Indeterminate——

Surgical consult & order CT scan

1214

1216

Order CT scan

1234

Does the patient have any neurologic deficit referable to the cervical spine?

No

Yes——

Order 3 x-rays*

1218

No

1206

Does the patient have any neurologic deficits?

——Yes——

1226

Is the neurologic deficit referable to the cervical spine?

No

Normal

Indeterminate

Abnormal

1222

Surgical consult & order CT scan

1224

Order CT scan

Yes

——No——

1208

Stable C-spine if patient can flex, extend, move neck left/right without pain and without neck tenderness to palpitation. You can remove collar.

1220

Stable C-spine if patient can flex, extend, move neck left/right without pain and without neck tenderness to palpitation. You can remove collar.

Yes

1228

Patient should obtain immediate spine trauma surgery consult and CT or MRI (if available)

* 1) Lateral view revealing the base of the occiput to the upper border of the first thoracic vertebra, 2) anteroposterior view revealing spinous processes of the second cervical through the first thoracic vertebra, and 3) an open mouth odontoid view revealing the lateral masses of the first cervical vertebra and entire odontoid process.

Oliguria (page 1)   **Figure 26**

1300
Is the patient Oliguric
(<25 cc/hr x 2 hrs)?

1302
Is the patient anuric
(<10 cc/hr x 2 hrs) in spite of fluid
administration?

Yes →

No →

1304
Determine whether the urinary
catheter is working by
flushing the catheter

1306
Is the catheter
functioning?

Yes →

No →

1308
Replace or
reposition the
catheter

1310
Does the patient
have a history of:
1) Renal stone disease?
2) Abdominal, pelvic, or retroperitoneal
cancer?
3) Recent pelvic or
retroperitoneal surgery?

No →

Yes

1318
1) Does the patient have a history of
heart failure or known ejection fraction < 30%
2) Are there rales on physical exam?

No →

Yes

1320
Administer fluids
10-20 ml/kg and

1312
1) Do renal ultrasound emergently to
rule out obstruction
2) While waiting for ultrasound
administer fluids 7-15 ml/kg and
3) Send urine for specific gravity

1322
Send urine
for specific
gravity

Q

No ←

1324
Has there been a
CXR in the last 6 hours?

Yes →

1314
Is
obstruction
present?

No →

Yes

1330
Is there evidence of edema or
congestion?

No →

Yes

1328
Administer
7-15
ml/kg
and

1332
1) Insert PA catheter to
measure wedge pressure and LV function to
direct fluid replacement
2) Send urine creatinine and sodium

1316
Consult a urologist
Immediately

1334
1) Do a CXR
2) Is there evidence of edema or congestion?

No ←

Yes ↑

1326
Has there been a
change in respiratory
status?

No ←

Yes ↑

No →

Specific Gravity <1.018   *1336*

1) Send blood and urine immediatly for...
BUN, Creatinine, Electrolytes, and Hgb,
and spot urine for creatinine, sodium, sediment

2) Administer 5-10 mL/kg fluid

Q

No → R

Yes

1338
What is the Hgb?

1340
Increased by > 1.5 gm/dL compared to the previous hgb

1352
Within 1.5 gm/dL from the previous hgb or no comparison

1362
Decreased by 1.5 gm/dL compared to the previous hgb

1342
1) Administer fluids 5-10 ml/kg Follow urine output closely

1354
What is the mean blood pressure?

1364
1) Transfuse PRBC's as needed
2) Look for source of bleeding Check PT, aPTT & platelet count

1356
Within 20% or higher than the baseline pressure

1358
>20% below the baseline pressure

1360
Give additional fluids & consider invasive hemodynamic monitoring

1344
Do labs confirm renal failure?

$$FE_{Na} = \frac{\text{Urine Na} \times \text{Serum Creatinine}}{\text{Urine Creatinine} \times \text{Serum Na}} \times 100$$

Yes
$FE_{Na} > 1\%$

1346
No
$FE_{Na} \leq 1\%$

1350

1348
1) Continue to administer fluids and follow urine output
2) Recheck creatinine in 6-12 hours

1) Place CVP
2) Assure adequate intravascular volume
3) Give trial of diuretics: 40 mg lasix IV, if no response in 1 hr, give hydrodiuril 500 mgIV, wait 20-30 min then give 100 mg lasix. If persistant oliguria, Restrict 1) fluids 2) potassium & phosphate. If diuresis ensues, restrict only potassium & phosphate. In both situations, adjust all renally excreted medications.
4) See acute renal failure

Figure 26B

Oliguria (page 3)

(R) → **Specific Gravity ≥ 1.018** *1364*

↓

Is the urine dark or tea colored? *1366*

No ← → Yes

No branch:

1370
1) Administer 10-20 ml/kg of fluids
2) Check hgb

→ What is the hgb? *1372*

Yes branch:

1368
1) Check creatinine phospho/kinase
2) Force fluids to induce diuresis

From "What is the hgb?":

1374
> 1.5 gm/dL higher than the previous hgb

1378
Within 1.5 gm/dL of last hgb or no hgb for comparison

1390
> 1.5 gm/dl below the previous hgb

1376
1) Force fluids
2) Continue to follow urine output

↓ (from 1378)

What is the Mean blood pressure? *1380*

1392
1) Transfuse blood as needed
2) Look for bleeding source
3) Check PT, aPPT & platelet count
4) Continue to push fluids
5) Recheck hgb in 1-2 hrs

From "What is the Mean blood pressure?":

1382
Within 20% or higher than the baseline pressure

1386
>20% below the baseline pressure

1384
1) Continue to administer fluids
2) Follow urine output
3) Check creatinine in 6-12 hrs

1388
1) Continue to push fluids
2) Consider invasive hemodynamic monitoring
3) If post-op abdominal trauma, consider abdominal compartment syndrome

OPEN FRACTURES

1500

Is there an exposed fracture? (Open to the surface)

1502 — Yes

No — 1522

Is there evidence of neuro-vascular damage?

Yes — 1524

Is/was the wound contaminated with soil, or did it occur in a barnyard?

No

Yes

04

Add high dose penicillin to the antibiotic regimen

1526

Is there evidence of compartment syndrome?

Consult Neurosurgeon or Vascular surgeon Stat

1530 — No

Yes — 1528

No

Consult Orthopedics

Consult Orthopedics Stat

1508

Is the skin wound over the open fracture?
1) <1cm in length and clean.
2) >1cm in length without extensive soft tissue damage.
3) Have extensive soft tissue damage or traumatic amputation.

Answer 3

1510

A. Is there adequate soft tissue coverage?

1512

B. Is there arterial injury requiring repair?

1506

Answer 1 or 2

1514

C. Is there extensive soft tissue injury with periostial stripping and bone exposure?

Administer
1) Tetanus Prophylaxis
and
2) Gram Positive (staph aureus) coverage preoperatively and for 24 hours postop.
3) Operative wound care should occur within 6 hours.
4) Fracture grade should be updated intra-operatively and if more extensive (grade 3) aminoglycosides should be added and the antibiotic coverage maintained for 72 hours.

1516

1518

1520

A) Risk of infection is :low, administer
1) Tetanus prophylaxis
2) Administer preoperatively and for 72 hours postoperatively
Gram positive (staph aureus) coverage
Aminoglycosides
+/- High dose penicillin
3) Operative wound care should occur within 6 hours.

B) Risk of infection is moderate- high
1) same as A.

C) Risk of infection is high
1) same as A.

Figure 28

PANCREATITIS
Diagnostic Evaluation

1600

1600 Are both severe epigastric ABD pain & Amylase (>3x normal) ↑present? ——No——▶ **1602** Consider other causes of ABD pain (mesenteric ischemia, perforated ulcer, intestinal obstruction, biliary colic, ectopic pregnancy)

Yes

1604 Are either Ranson criteria > 3 or Apache II score >8? ——No——▶ **1606** Consider supportive care in non ICU environment

Yes

1607 Perform ABD US within 24 hours Is Biliary obstruction present? ——Yes——▶ **1608** Consider ERCP to locate & remove gallstones

No

1610 Perform Dynamic IV contrast, abdominal CT scan at ≥ 3 days. Perform sooner for suspected surgical condition (perforated ulcer, mesenteric infarction or pancreatic infection). Avoid IV contrast if creatinine ≥ 2 mg/dl

1612 Is necrotizing pancreatitis present on CT scan? ——No——▶ **1632** Observe closely and utilize treatment regimen

Yes

1614 Has there been clinical improvement since admission? ——Yes——▶

No ▶ **1616** Perform CT guided percutaneous fluid aspiration with gram stain & culture ◀—Yes— **1634** Has clinical deterioration (↑ organ failure) occurred? ——No——▶ **1636** Continue to observe

1618 Infection   **1622** Sterile

1620 Surgical debridement

1624 Close follow-up ——▶ **1626** Clinical Deterioration ——No——▶ **1630** Continue to follow closely

——Yes——▶

Surgical debridement

1628

Penicillin Allergy

Figure 29

1700

Does the patient present with a history suggestive of previous penicillin (pcn)/ cephalosporin (ceph) anaphylaxis?
Angioedema
Flushing
Pruritis
Airway Obstruction
Syncope
Hypotension

1702

Yes →

No →

1718

Has the patient ever received either ampicillin, amoxicillin, duricef or kefzol without symptoms of anaphylaxis?

1706

Yes → **Patient can probably be given pcn/ceph agents.**

Does the patient have a history of any of the following?
1) Exfoliative Dermatitis.
2) Stevens Johnson Syndrome.
3) Toxic Epidermal Necrolysis
to pcn or ceph.

No ↓

1704

Administer Alternate Antibiotics.

No ← **Does the patient need a pcn/ceph agent?**

1716

No ↓ (to 1722)

Yes ↓

1708

Consider Allergy/Immunology consultation Do skin testing preferably to both major & minor determinants.

Yes → 1720

Patient cannot receive these agents, look for alternative antibiotics.

1722

Does the patient have a history of a rash only to pcn/ceph?

No → 1724 **Patient can probably be given pcn/ceph agents.**

1710

Is skin test positive?

No ↓

1712

Yes or don't know

Yes ↓ 1726

Was the rash related to administration of ampicillin or amoxicillin?

Administer pcn/ceph with caution. Consider pretreatment with benadryl & prednisone and monitor closely.

Yes ↓ 1728

1730

Yes →

Was the rash urticarial?

No → **Patient can probably be given pcn/ceph with caution monitor closely.**

1714

Do Desensitization to specific agents.

Post-Op Hypertension

Figure 30

1800 — Is the patient hypertensive (BP >20% above mean baseline)?

1802 — **Yes →** Does the patient have any of the causes of reversible hypertension?
1. Hypercapnia
2. Bladder distension
3. Pain
4. Increased ICP
5. Drugs (pressors, cocaine, ketamine and chronic MAO use with indirect acting vasopressors)
6. Autonomic hyperreflexia
7. Volume overload

No (from 1800) → *1832* — Does the patient require their BP controlled near baseline (i.e. neurosurgery, carotid surgery, thoracic aorta surgery)?

Yes → *1804* — First treat those specific etiologies. If pressure remains high, re-enter algorithm

No → *1806* — Is the patient at risk of injury from post-op hypertension (i.e. vascular surgery, coronary artery disease, neurosurgery, ocular surgery, etc)?

1808 — Is the BP>40% above mean baseline

No → *1810* — May not need B.P. treatment

1812 — Is the patient in pain?

1830 — Is the blood pressure >40% above baseline?

1836 — Is the patient in pain?

1834 — Probably does not need treatment

Yes → *1814* — Treat pain and continue

1816 — Is the patient actively bleeding or at significant risk for post-op bleeding (i.e. "moist closure" or high drain output)

1838 — Treat pain & reevaluate following analgesia, if still hypertensive continue algorithm

1818 — Use only short acting agents including esmolol and nitroprusside as needed until bleeding has abated

No → *1820* — Is the patient tachycardic? Absolute > 90bpm, or (relative > 15% over baseline)

Yes → HR High Table
No → Not HR High Table

1822 — Is the patient bradycardic? (absolute < 60 bpm)

Yes → HR Low Table
No → Not HR Low Table

1824 — Does the patient have known coronary artery disease (CAD) or 3 or more risk factors for CAD?

No → Input to Table
Yes → Input to Table

1826 — Does the patient have known reactive airway disease?

No → Input to Table
Yes → Input to Table

1828 — Does the patient have known EF<30% or a history of systolic heart failure?

No → Input to Table
Yes → Input to Table

Pulmonary Embolism

2904

2902

2900

1) Is the patient hemodynamically unstable (BP < 80 mmHg, in spite of fluid and/or pressor administration)?

No → Perform VQ Scan and continue

Yes → Consider immediate:
1. Trans-thoracic echocardiogram to look for right ventricular changes
2. Pulmonary Angiogram
3. Treatment [link to pulmonary embolism, treatment massive pulmonary embolus]

2906

2) Does the patient have? (answer yes to all that apply)
·Dyspnea
·Worsening chronic dyspnea
·Pleuritic chest pain
·Chest pain that is non- retro sternal & non-pleuritic
·O2 saturation < 92% on room air that corrects with 40% O2 supplementation
·Hemoptysis
·Pleural rub

2908

3) Are any of the following risk factors present: Yes/No?
1. Surgery within 12 weeks
2. Immobilization (complete bed rest) for > 3 days within 4 weeks
3. Previous DVT or objectively diagnosed PE?
4. Lower extremity fracture & immobilization within 12 weeks
5. Strong family history of DVT or PE(> 2 family members with objective proven events or 1st degree relative with hereditary thrombophilia)
6. Cancer (treatment within the last 6 months or palliative stages)
7. Postpartum
8. Lower extremity paralysis

2910

4) Does the patient have?: (answer yes to all that apply)
A.one or more of:
·Heart rate > 90 beats/min
·Temp > 38.0
·CXR free of abnormalities (edema, pneumonia, pneumothorax)
·Leg symptoms c/w DVT
B. one or more of:
·Syncope
·Blood pressure < 90 mmHg with heart rate > 100 beats/min
·Receiving mechanical ventilation and/or O2 supplementation > 40%
·New onset right heart failure (- JVP, new S1, Q3, T3, or RBBB)

2912

5) Is an alternative diagnosis as or more likely than PE? Yes/No

Conditions that simulate major PE:
1. Myocardial Infarction
2. Acute infection with COPD
3. Septic Shock
4. Dissecting Aortic Aneurysm
5. Occult Hemorrhage

Conditions that simulate minor PE:
1. Acute Bronchitis
2. Pericarditis
3. Viral Pleurisy
4. Pneumonia
5. Esophageal spasm

S

Figure 31

Pulmonary Embolism

2914

Typical PE
≥ 2 points from #2
and 1 from 4a

2916

Alternative
diagnosis
as likely or more
likely than PE

2918

No risk
factor
**Low
probability**

Risk
factor
**Moderate
probability**

2922

Alternative
diagnosis
less likely than
PE

2920

No risk
factor
**Moderate
probability**

2924

Risk
factor
**High
probability**

2926

S

2928

Atypical PE
< 2 points from #2

2930

Alternative
diagnosis
as likely or more
likely than PE

2932

No risk
factor
**Low
probability**

2934

Risk
factor
**Low
probability**

2936

Alternative
diagnosis
less likely than
PE

2938

No risk
factor
**Low
probability**

2940

Risk
factor
**Moderate
probability**

2942

Severe PE
Typical + 1 from
4b or any 2 from
4b including new
heart failure

2944

Alternative
diagnosis
as likely or more
likely than PE

2946

**Moderate
probability**

2948

Alternative
diagnosis
less likely than
PE

2950

**High
probability**

Figure 31A

Seizure Algorithm

2000

0 -30 minutes

1) Lorazepam (0.1 mg/kg) in
2 mg boluses up to 8 mg

2002

2) Phenytoin (18-20 mg/kg) at 50 mg/min
or
Fosphenytoin (18-20 mg/kg) at 150 mg/min
followed by 5 mg/kg/day
through separate IV line

2004

30-60 minutes

3) a) Reload additional Phenytoin or
Fosphenytoin at (10mg/kg) maintaining
previous infusion
b) Give additional Lorazepam (0.05 mg/kg)

2008

Hemodynamically
Stable

2006

**Begin continuous
EEG monitoring**

2016

Hemodynamically
Unstable

2010

4) Propofol
1-2mg/kg bolus
followed by
2-10mg/kg/hr

2018

4) Utilize fluids and pressors as
needed (phenylephrine or dopamine)
Midazolam
0.2mg/kg bolus followed by 0.1-2.0
mg/kg/hr

2012

If seizure activity stops, taper either
midazolam or propofol over the next
12-24 hours while maintaining
phenytoin. If seizures persist, move to
pentobarbital coma

Beyond 60 mins

2014

5) Pentobarbital Coma
10-15 mg/kg bolus followed by
0.5-1.0 mg/kg/hr
Maintain until seizure control is
achieved on EEG. Patient usually
requires PA catheter and pressors to
maintain hemodynamic control.

Figure 32

2100

SVT Determination

2101 ● Unstable → (T)

Fig. 33

2102 STABLE

2104 Regular Rhythm

2140 Irregular Rhythm

2128 Narrow Complex

2106 Wide Complex

2142 No p waves probable A-fib

2130 Adenosine 6 mg/12 mg (if needed)

2108 Adenosine 6 mg/12 mg (if needed)

2144 Slow ventricular response with esmolol or CA+2 blockers

2134 Converts to SR-Consider Re-entrant sinus or junctional. If recurs, treat with esmolol or Ca+2 blockers

2146 >3 p wave types MAT - treat underlying lung dz. Avoid theophylline cmpds

2110 Converts to SR-Consider Re-entrant junctional or WPW re-entrant. If recurs- treat with esmolol or Ca+2 blockers.

2112 No effect-Consider V-tach

2116 Slows-Consider SVT w/ aberrancy. Continue to slow with esmolol or Ca+2 blockers

2132 Slows ventricular rate only. Atrial rate persists consider atrial flutter. Continue to slow with esmolol or Ca+2 blockers

2136 Slows both atrial and Ventricular rates Probable sinus tach

2148 Slow rate with Ca+2 blockers only

2138 Continue to slow with esmolol

2114
1. Load procainamide 150 mg over 10 min, then 1 mg/min infusion
2. Synchronized cardiovert

2118 **Esmolol**/Calcim Blockers Link to Ventricular Rate Control

No

Yes

2120 Conversion to SR

2122 No conversion to SR in 24 hours, add antiarrhythmic agent; consider anticoagulation

2124 Conversion to SR. Continue maintenance antiarrhythmic agent during hospitalization

2126 No conversion cardiovert while on antiarrhythmic & following heparinization

Figure 33

SVT Unstable

Fig 33A

Unstable
(SBP < 80, ischemia, mental status changes) — 2150

Synchronous cardioversion (100 J, 200 J, 300 J) — 2152

Sinus rhythm: — 2154
1) Correct reversible etiologies
2) Consider starting IV antiarrhythmic for maintenance of sinus rhythm

Continued SVT: — 2156
1) Correct reversible etiologies
2) Load IV antiarrhythmic (see dosing guidelines) and repeat DC cardioversion

Wide Complex QRS Tachycardia

Fig. 34

2200
Is the patient hemodynamically stable? No angina, heart failure or hypotension (systolic <80mm).

— No → Link to cardio-pulmonary guidelines

Yes ↓

2202
Is the patient within 7 days of a myocardial infarction or at risk for myocardial ischemia?

— No → **2234**
Is the wide complex QRS rhythm sustained (>30 seconds)?

Yes ↓ (from 2202)

2204
Is the wide complex sustained? (30 seconds)

Yes ↓

2206
Is the rate >140/min?

— No → **2212**
Is the patient:
1) Symptomatic or
2) Tachycardia runs are frequent or
3) The tachycardia rates are rapid >180?

2216
Observe

2218
Consider accelerated idioventricular. In some patients this can lead to hemodynamic compromise.
1) Can perform overdrive pacing if needed.

No → Observe (2216)

Yes (from 2212) ↓

2214
1) Administer lidocaine 100-200 mg & 1-4 mg/min infusion
2) Amiodarone

2234 / 2236
Is the QRS monomorphic?

Yes → **2242**
Does the patient have structural heart disease?

No ↓ (from 2236)

2238
Is the QT prolonged?

— No → (to 2242)

Yes ↓

2240
1) Check K
2) Give Mg
3) Consider overdrive pacing.

2242 Does the patient have structural heart disease?

Yes → **2244**
1) Monitor closely.
2) Look for reversible etiologies.
3) Consider antiarrhythmic therapy.

No → **2246**
1) Monitor closely.
2) Look for reversible etiologies.
3) If recurs and symptomatic may require further testing (prolonged holter or EP study).

2208
Is the rhythm polymorphic or irregular?

Yes ↓

2210
Consider atrial fib with accessory pathway conduction. Load with procainamide and get cardiology consultation.

No → **2220**
Do you wish to
1) Perform ECG Diagnosis or
2) Administer adenosine diagnostically?

→ (u)

↓

2222
Administer adenosine

→ **2224**
No effect. Probable VT. Is the VT monomorphic?

Yes ↓ → **2226**
1) Load with procainamide and perform synchronous cardioversion.

No → **2228**
1) Load with lidocaine and perform immediate cardioversion.

2230
Slows ventricular response. Consider SVT with aberrancy. Treat with esmolol or Ca blockers

2232
Converts to sinus rhythm. consider re-entrant mechanism with BBB or WPW.
1) If WPW consult cardiology for possible ablation.

Fig. 34A

(U)

**Wide Complex QRS Tachycardia
(page 2)
ECG Diagnosis**

2300

Does the patient have known pre-excitation syndrome?

Yes / No

2302
Are the QRS complexes predominantly negative in leads V4-V6?

2304
Probable VT
←Yes

No ↓

2306
Is there a QR complex in one or more of leads V2-V6?

2308
Probable VT
←Yes

No ↓

2310
Are there more QRS complexes than P waves?

2312
Probable VT
←Yes

No ↓

2314
Consider pre-excited SVT.
May wish to perform EP study.

2316
Is an RS Complex present in any precordial lead?

2318
Probable VT
—No→

Yes ↓

2320
Is the R to S interval > 100 MS in any one precordial lead?

2322
Probable VT
—Yes→

No ↓

2324
Is there evidence atrioventricular dissociation?

2326
Probable VT
—Yes→

No ↓

2328
Is V-1 negative and V-6 positive and QRS > 0.14 mSEC

2330
Probable VT
—Yes→

No ↓

2332
May represent SVT with aberrancy or underlying bundle branch block.

Fig. 41

SEDATION

ASSESSMENT of SEDATION   3100

1. SCORING   3102

ALERTNESS   3104
Asleep/unresponsive=0
Responsive to voice=1
Hyperresponsive=2

MOVEMENT   3106
No spontaneous movement=0
Spontaneous movement=1
Pulls at lines, tubes, dressings=2

RESPIRATION   3108

Mechanically Ventilated   Spontaneously Breathing
No spontaneous ventilation=0   RR < 10 =0
Spontaneous ventilations and synchronous with ventilator=1   RR = 10-30 =1
Spontaneous ventilations with cough or dysynchrony > 10 %   RR > 30 =2
of breaths=2

HEART RATE   3110
>20% below mean for last 4hr=0
Within 20% mean for last 4hr=1
>20% above mean for last 4hr=2

BLOOD PRESSURE   3112
MAP >20% below mean for last 4hr=0
MAP Within 20% mean for last 4hr=1
MAP >20% above mean for last 4hr=2

⊗

Note:
Respiratory rate, heart
rate, and BP can be
computer linked to
monitor data, thereby
simplifying the sedation
scoring assessment. The
nursing observations are
intuitive. I believe the
nursing burden in
sedation scoring can be
minimal with this point
score.

SEDATION SCORE=   3114
Alertness+Movement+Respirations
+Heart Rate+ Blood Pressure

Contiue   3116
sedation
assessment

Sedation
Assessment
Continued

Figure 41A

2. PAIN ASSESSMENT

Is patient conscious, communicative, and acknowledging pain?

If not, is the sedation score >2 and the patient:
known to be in pain before becoming uncommunicative
OR
S/p recent surgery
OR
Having tissue ischemia or infarct
OR
S/p recent fracture
OR
Has wounds
OR
Has large tumor possibly impinging on nerves?

If YES, treat for pain.

3118

3. DELIRIUM ASSESSMENT

Is sedation score >2 AND patient has:
Day/night reversal with increased agitation at night
OR
Eyes open and "awake" but disoriented
OR
Eyes open and "awake" but pulling at lines, tubes, or dressings
OR
Difficult to sedate prior to ventilator weaning
OR
Paradoxical response to benzodiazepines?

If yes, consider butyrophenone.

3120

Fig. 42

Bolus sliding scale midazolam 3200

3202

If lorazepam <0-2 mg IV q 6hr then give midazolam 1-2 mg q 5min until adequately sedated

If lorazepam =2-4 mg IV q 4hr then give midazolam 2 mg q 5min until adequately sedated

If lorazepam =5-10 mg IV q 4hr then give midazolam 2-5 mg q 5min until adequately sedated

If lorazepam >10 mg IV q 4hr then give midazolam 5 mg q 5min until adequately sedated AND consider fentanyl and/or droperidol or Haldol for synergy despite delirium and pain assessment

Figure 43

```
            ┌─────────────────────┐
            │  SEDATION ALGORITHM │
            └─────────────────────┘
                      │
        ┌─────────────────────────────┐       3300
        │    Sedation Assessment      │
        │ 1. Scoring 2. Pain 3. Delirium│
        └─────────────────────────────┘
                      │
                      ▼          3302                          3324
              ◇─────────────◇   Y    ┌──────────────────────────────────┐
              │ Is patient  │───────▶│ Bolus morphine, fentanyl, other   │
              │  in pain?   │        │ narcotic, start PCA or epidural    │
              ◇─────────────◇        │ analgesia as indicated             │
                      │ N            └──────────────────────────────────┘
                      ▼          3304                          3326
              ◇─────────────◇   Y    ┌──────────────────────────────────┐
              │ Is patient  │───────▶│ Droperidol 2.5-5 mg q30min prn     │
              │ delirious?  │        │ May consider IV Haldol not to      │
              ◇─────────────◇        │ exceed 30mg/24hr                   │
                      │ N            └──────────────────────────────────┘
                      ▼          3306
              ◇─────────────────◇   N        (V)
              │ Will patient need│──────────▶
              │ sedation for >   │
              │   next 24hrs?    │
              ◇─────────────────◇
                      │ Y       3308
    3328              ▼
┌──────────────┐   ◇─────────────────◇  Y
│ Bolus sliding│◀──│ Sedation score   │
│ scale        │   │     8-10?        │
│ midazolam and│   ◇─────────────────◇
│ Increase     │           │ N      3310
│ lorazepam by │           ▼
│    20%       │   ◇──────────────────◇
└──────────────┘   │ Sedation score ≥  │  Y
       │           │ last Sed Scr after │
       ▼  3330     │ sedative bolus or  │
┌──────────────┐   │    increase        │
│  Reassess    │   ◇──────────────────◇
│ sedation in  │           │ N      3312
│    4hr       │           ▼
└──────────────┘   ◇──────────────────◇
                   │ ≥4 midaz boluses   │  Y
                   │ given since last   │
                   │  q4hr assessment   │
                   ◇──────────────────◇
                           │ N      3314
                           ▼
          N        ◇──────────────────◇
       ◀──────────│ Is patient         │
                   │ adequately sedated?│
                   ◇──────────────────◇
                           │ Y      3316                      3332
                           ▼
                   ◇──────────────────◇  Y    ┌──────────────────────────┐
                   │ Sedation score 0-2 │─────▶│ Decrease lorazepam by 20% │
                   ◇──────────────────◇        └──────────────────────────┘
                           │ N      3318                      │
                           ▼                                  ▼  3334
                   ◇──────────────────◇  Y    ┌──────────────────────────┐
                   │ Sedation score ≤  │──────▶│      Reassess             │
                   │ last Sed Scr after │       │   sedation in 4hr         │
                   │ sedative decrease  │       └──────────────────────────┘
                   ◇──────────────────◇
                           │ N      3320
                           ▼
                   ◇──────────────────◇  Y
                   │ Is patient         │──────┘
                   │ clinically         │
                   │  oversedated?      │
                   ◇──────────────────◇
                           │ N
                           ▼          3322
                   ┌──────────────────┐
                   │    Reassess       │
                   │  sedation in 4hr  │
                   └──────────────────┘
```

Figure 44

Short term (<24hr) Sedation process

3100 — Sedation Assessment: 1. Scoring 2. Pain 3. Delirium → Go to Assessment of Sedation Algorithm Fig. 41

(V) →

Decrease lorazepam by 20% from baseline per day *3102*

3104 Is patient in pain? — Y → Bolus morphine or fentanyl *3122*

N

3106 Is patient delirious? — Y → Droperidol 2.5-5 mg q30min prn *3124*

N

3126 Bolus sliding scale midazolam, begin midazolam infusion, or begin propofol 1-2 mg/kg bolus and 5-50 mcg/kg/min infusion. ← Y — *3108* Sedation score 8-10?

N

3128 Reassess sedation in 1hr

3110 Sedation score ≥ last Sed Scr after sedative bolus or increase — Y

N

3112 Is patient adequately sedated? — N

Y

3114 Sedation score 0-2 — Y

N

3116 Sedation score ≤ last Sed Scr after sedative decrease — Y

N

3118 Is patient clinically oversedated? — Y

N

3120 Reassess sedation in 1hr

3130 Has patient been sedated >72hrs? — N

Y *3136* Hold midazolam or propofol and decrease lorazepam by 20% per day

3132 Hold midazolam or propofol and hold or decrease lorazepam by 50%

3134 Reassess sedation in 1hr

Respiratory Isolation

Fig. 45

3500 — Determine need for respiratory isolation based upon
a) clinical assessment
b) smear/culture findings

3502 A) Does the patient have known mTB?

3512 Has the patient been compliant with their medications for over 2 weeks and is clinically responding?

— YES →

NO → **3514** Isolation required

YES → **3516** No isolation required

3504 Does the patient have known mycobacterial disease other than TB?

YES →

3518 Does the patient have new CXR findings and symptoms (cough 2 weeks, fever, weight loss)?

NO → **3520** No isolation required

YES → **3522** Isolation required

3506 Is there a new cavitary lesion on CXR?

YES → **3524** Isolation required

NO →

3508 Are there pulmonary infiltrates or is the patient HIV+

YES →

3526 Does the patient have new CXR findings and symptoms (cough 2 weeks, fever, weight loss) **and** at high risk
1) Known mTB exposure
2) Homeless
3) Prisoner
4) Travel to area with multi-drug resistant TB

YES → **3528** Isolation required

NO → **3530** No isolation required

NO → **3510** No isolation required

3532 B) Is the AFB smear positive?

NO →

3534 No Isolation required. Await culture results. If culture negative, no isolation required. If culture positive and patient has mycobacterial disease other than TB (MOTT) no isolation required. If the culture is positive and the patient does not have MOTT consult ID

YES →

3536 Does the patient have known mycobacterial disease other than TB?

YES → **3540** Isolate until results of NAP test are in. If mTB, positive isolate If no mTB, no isolation required

NO → **3538** Isolation required

Figure 47

**Empiric
Meningitis
Treatment**

1.
Is the patient a victim of
head trauma or s/p
neurosurgery?

3700

2
Is the patient penicillin
allergic or from an area with
high level penicillin resistant
S. Pneumoniae?

3702

3.
Is the patient
immunocompromised?

3704

4.
Is the patient
>50 years old?

3706

5.
Does the patient have
altered mental status?

3708

Comparison

3710

Dosage Instructions

3712

VENTILATOR WEANING /3800

Daily Screen: perform between 0600 and 1000
1. P/F > 200 AND
2. PEEP ≤ 5 AND
3. Adequate cough with suctioning (or spontaneous) AND
4. No infusions of vasopressors (Dopamine ≤ 5 μg/kg/min) AND
5. No continuous infusions of sedatives or neuromuscular blocking agents

/3805

| Rescreen next morning | ◄—N— | All 5 screening criteria met? | /3802

/3804

Rapid Shallow Breathing Test (Adapted from Tobin)
1. Change mode to CPAP ≤5 (NO IMV and NO Pressure Support)
2. Give 1 minute to reach steady state
3. Measure f/V_T ratio where f = breaths per minute and V_T =tidal volume in Liters.
If measured over a minute, V_T =minute ventilation/f

/3808

| Rescreen next morning | ◄—N— | Rapid Shallow Breathing Test shows f/V_T ratio ≤ 105? | /3806

Trial of Spontaneous Breathing /3810
Place on T-Piece or CPAP ≤ 5 (NO IMV or PS) for 2hr.
Terminate if periodic assessment failed.

Periodic Assessment /3812
Terminate weaning trial if:
f>35 for 5 minutes OR
SpO_2 <90% OR
HR > 140 OR
HR >20% over or <20% under baseline OR
SBP >180 or <90

/3814
Successful 2hr trial of spontaneous breathing? AND
Able to defend airway (cough, no obstruction,
manageable secretions, requires suctioning less than
q2hr)? AND
No procedure planned next 24hr requiring patient to
be intubated?

| Progressive weaning |

(W) 3818

EXTUBATE 3816

Figure 48

W

OR

T-Piece Progressive Weaning
1. Repeat TP trial as above q24hr
2. Extubate (below) when able to pass 2hr trial.
3. May consider as little as 30 min trial if clinically indicated

3820

Pressure Support Progressive Weaning
1. PS=18 ± PEEP ≤5
2. Adjust to keep RR= 20-30
3. Decrease by 2-4 cmH20 BID as tolerated
4. Extubate (below) when tolerating P S= 5-8 cmH2O ≥ 2 hr

3822

Periodic Assessment
Terminate weaning trial if:
f>35 for 5 minutes OR
SpO$_2$ <90% OR
HR > 140 OR
HR >20% over or <20% under baseline OR
SBP >180 or <90

3824

3826

Successful progressive weaning (as above) AND
Able to defend airway (cough, no obstruction, manageable secretions, requires suctioning less than q2hr)? AND
No procedure planned next 24hr requiring patient to be intubated?

N

Y

Rest on A/C or last level of PS tolerated for ≥ 12 hr

3830

EXTUBATE

3828

Progressive weaning resume next morning

3832

Figure 48A

Figure 49

Warfarin Dosing Algorithm

3900

1.Give warfarin initial dose as directed and check the INR the following day (day 2). The INR should ideally be checked as close as possible to the next dose to determine the maximal effect.

3902

What is patient's target INR?
1.5 - 2.0 = load with 5mg
2.0 - 3.0 = go to next questions
3 - 4.0 = load with 10mg

INR=1.5-2.0 or 3-4.0

INR=2.0-3.0

3904

·Is the patient on any drugs that will effect prothrombin time? Yes/No
No = 0
Yes =
Prolong= -1
Shorten= +1
Both= 0

3906

What is the patient's baseline PT/INR?
< 1.0 =   0
1.1 - 1.2 = -1
1.3-1.5 = -2

3908

·Is rapid anticoagulation required?
Yes = +1
No = 0

3910

Total points
> 1 = Output load with 10 mg
< 1 = Output load with 5 mg

3912

2.Enter the day of treatment (2-6).

3914

3.Enter the patient's INR.

3916

compare to dosing chart

3918

Output the warfarin dose from table to be administered

Figure 51

HIT-2 diagnostic algorithm
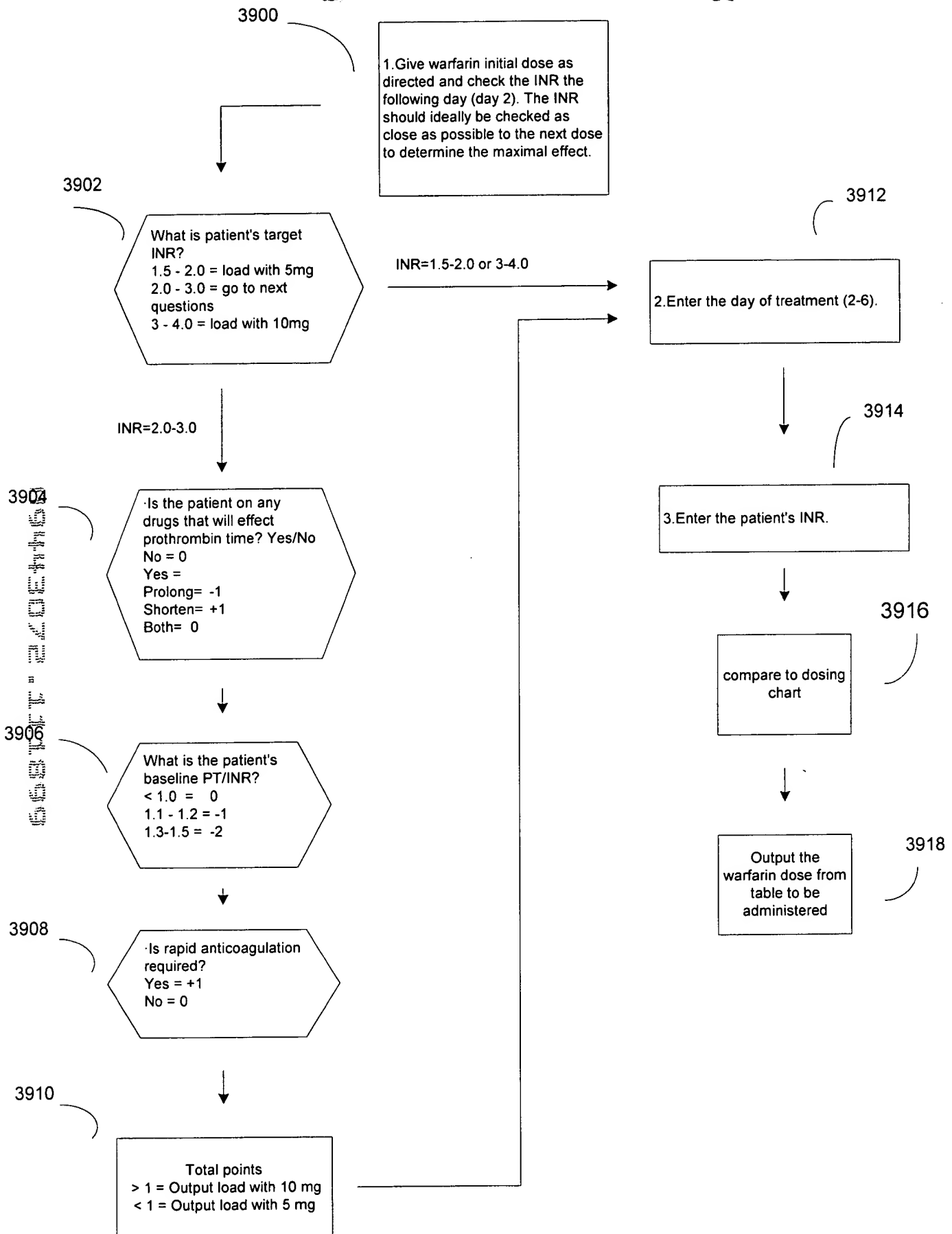
4100

While treated with heparin did the
platelet count drop rapidly to 50% of
baseline over no more than 72 hours
with no other obvious causes
(bleeding, infection, other drugs)?

──Yes── ──No──

4104

Was the patient
treated wih
heparin for at > 3
days?

4102

Diagnosis of HIT-2 unlikely
Continue to monitor platelet
count.

──No──

4106

Yes

Did the patient receive
heparin within the last 3
months?

──Yes──

4110

Is there clinical evidence of
thrombosis?

4108

No

Yes

No

4112

1. HIT-2 likely
2. Stop heparin exposure
(including catheters & flush solution)
3. If continued anticoagulation is required,
consider Danaproid or Hirudin treatment as a bridge
to warfarin anticoagulation or for ongoing parenteral
anticoagulation.

1. Diagnosis of HIT-2 unlikely.
2. Continue to monitor platelet count for infection or other
drug causes of thrombocytopenia
3. Consider stopping heparin therapy. If platelet count
goes below 50,000/mm-3.

4114

Is there evidence of
heparin resistance?
(Difficulty prolonging
the aPTT in spite of
increasing doses of
heparin)

──Yes── ──No──

4116

4118

1. Consider stopping heparin
2. If continued anticoagulation is required,
consider Danaproid or Hirudin treatment as a bridge
to warfarin anticoagulation or for ongoing parenteral
anticoagulation.

1. Diagnosis of HIT-2 possible.
2. Continue to monitor platelet count and patient for
thrombosis.
3. Continue to monitor platelet count for infection or other
drug causes of thrombocytopenia
4. Consider stopping heparin therapy if platelet count
goes below 50,000/mm-3.